ARIZONA NEWBORN SCREENING

ANNUAL REPORT 2006

Office of Women's & Children's Health

Arizona Department of Health Services

www.AZNewborn.com

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Acknowledgements

The Arizona Newborn Screening Program requires many people to make the system work well. We have succeeded in delivering a high quality of care only because of the following people working together:

- Parents
- Arizona birthing hospitals
- Pediatricians
- Metabolic Geneticists
- Neonatologists
- Pediatric Endocrinologists
- Pediatric Hematologists
- Audiologists
- Hearing screeners
- Nurses
- Social services
- Midwives
- March of Dimes
- American College of Medical Genetics
- Arizona Chapter of the American Academy of Pediatrics
- National Center for Hearing Assessment and Management
- National Newborn Screening and Genetics Resource Center
- Sonora Quest Laboratories
- LabCorp
- Cystic Fibrosis Centers
    - Phoenix Children's Hospital
    - Arizona Respiratory Center in Tucson
- Arizona Department of Health Services
    - Bureau of Women's and Children's Health
    - Arizona State Laboratory, Data Entry, & Billing Services
    - Follow-up
    - Nutrition
    - Assessment and Evaluation
    - Information Technology Services

Thank you very much! The State of Arizona Department of Health Services appreciates your work and thanks you on behalf of our employees working in Newborn Screening and all babies born in Arizona.

Overview of Newborn Screening

- Our tests could save a baby's life.

- All Arizona newborns are tested and we help those who have certain rare, inherited diseases or hearing loss.

- Most babies are healthy when they are born. A few babies look healthy but have a rare health problem.

- Early identification and treatment can help prevent serious results like mental retardation or death.

Newborn screening can be divided into two categories: blood spot and hearing. Blood spot screening involves testing a small amount of blood for rare, inherited disorders. Hearing screening involves using special acoustic instruments to detect if babies can hear normally.

Blood Spot Detected Disorders

- Before leaving the hospital, a nurse will take a few drops of blood from each baby's heel. The blood is placed on special filter paper.
- The hospital will send the blood sample to the newborn screening lab.
- Arizona collects two samples to ensure no disorders are missed.
- Results are sent to the provider who ordered the screen.

If the results of the Newborn Screening test are unusual, then the baby's doctor is notified immediately and the doctor may request additional testing. Treatment can include: special diets, vitamins, medication, and education on the disorder.

Hearing Loss

Hearing loss is the most common congenital condition in the United States (American Academy of Pediatrics).

- Every baby should be tested before leaving the hospital.
- Some babies will be referred for additional testing.
- The hospital will write results on the back of the immunization record.

If additional testing results remain abnormal, the baby may need more evaluation by an audiologist. The Arizona program encourages and assists parents in getting special services for their babies. Hearing assistance can include: hearing aids, implants, and education for the hearing impaired.

Newborn Screening in Arizona

Each State has a different system for conducting newborn screening. Some States mandate screening while others do not. Some States collect one blood spot specimen while others collect two. Some States conduct the tests themselves while others contract with laboratories either in or out-of-state for specimen testing.

Arizona state law requires physicians to request newborn screening but parents may refuse and need not cite a reason for such refusal. Hearing screening remains a recommendation but results are required to be submitted for adequate follow-up. However, all birthing hospitals in 2006 voluntarily conducted hearing screening as a standard of care for newborns. Arizona maintains the "1-3-6" goal of universal hearing screening; screen each baby by one month of age, obtain needed audiological evaluations by three months of age, and provide treatment interventions by six months of age.

Arizona collects two blood specimens for blood spot screening. Specimens are destroyed approximately three months after receipt for testing.

Diagram of Blood Spot Screening Process

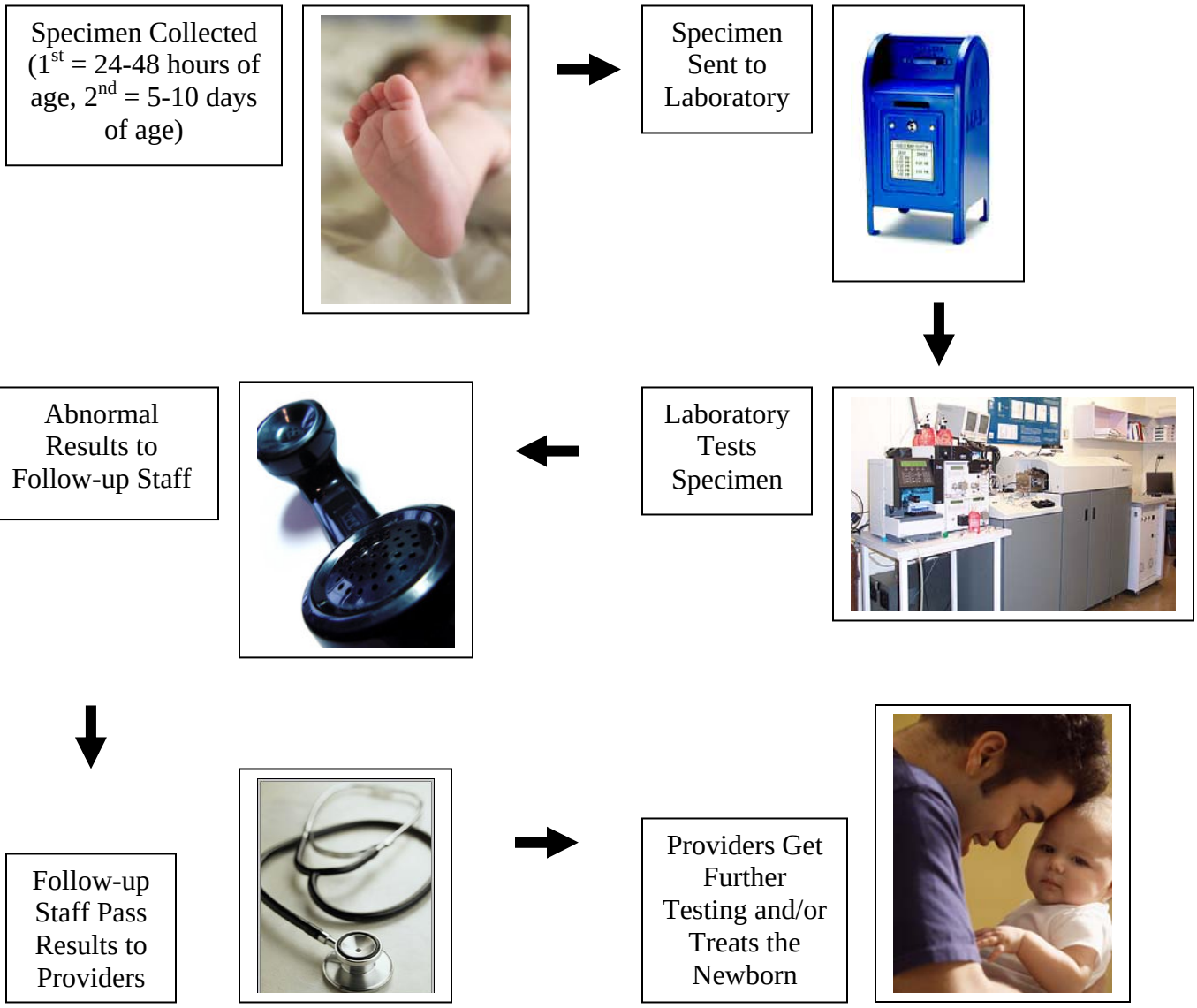
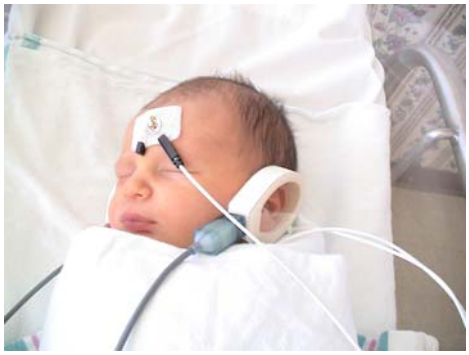


Diagram of Hearing Screening Process

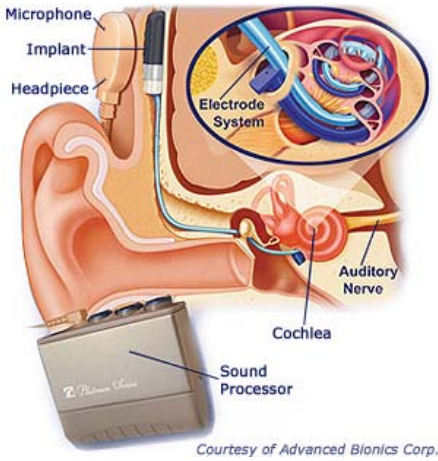
Hearing Tested in Hospital



Newborn Passes or is Referred for More Tests

Abnormal Results Should be Followed by a Pediatric Audiologist

Baby Receives Hearing Assistance: Possibly Aids or Cochlear Implants



Story of Baby with PKU

The following story was submitted by a mother and has not been changed:

My daughter was born in June 2006. I am extremely thankful for the Newborn Screening Program because without it, my daughter would not be the healthy baby she is today.

When she was 8 days old, I received a disturbing phone call from her doctor's office that she has PKU. I didn't know anything about PKU. All the doctor's office would tell me is that she needed to get to an emergency room ASAP (I later learned that I was greatly misinformed). When I asked what the implications of the PKU test results were, the lady told me that she wasn't an expert, but that it had something to do with brain damage. She reinforced the urgency of getting to the emergency room at St. Joseph's Hospital immediately.

My husband and I tearfully and anxiously rushed her to the emergency room. Luckily the admitting nurse realized that we should not be there. She tried to call Dr. Aleck, our PKU doctor, and my doctor's office, but couldn't get a hold of the correct people we needed to speak to so that we could figure out where we needed to be. Now we were not only worried and upset, but we were also confused and felt helpless. So we went back home.

Shortly after we returned home, we received a call from the genetic nutritionist at the Children's Rehabilitation Services clinic. She patiently listened to us and began to briefly educate us about PKU. It was a lot of information to take in, but she gently talked with us and calmed our fears. She told us to go to the CRS clinic at St. Joseph's Hospital so we could meet with many of the metabolic workers that will be caring for our daughter while we are here in Phoenix.

My husband and I will always remember the shock of getting that horribly chaotic phone call. It was such an awful way to find out about the results of our daughter's Newborn Screening. That said, I am grateful for the test because had my daughter gone without it, she would have seemed "normal" until she was six months old, and by then we would have realized she was mentally retarded and it would have been too late for treatment. Now that my husband and I are informed about PKU, we realize that as long as we keep her on the low-protein diet, she will lead a perfectly happy and healthy life. That is a priceless gift.

Recent Progress

- **Expansion of Disorder Panel**

In 2005, the Arizona Newborn Screening Committee recommended expansion of the panel of disorders detectable by blood spots. Arizona Department of Health Services and the Newborn Screening Program accepted and adopted their recommendation, beginning the expansion in April, 2006. All Arizona newborns are now screened for 28 disorders including hearing loss. Expansion was possible with the use of tandem mass spectrometers (MS/MS), allowing laboratories to test for many disorders with the same small amount of blood. In 2007, Arizona will also screen babies for cystic fibrosis. Cystic Fibrosis will complete the nationally-recommended panel of 29 disorders including hearing loss.

Arizona continues to test each newborn twice. The 1st specimen should be collected between 24 and 72 hours of age, or before a transfusion, or before discharge from a healthcare facility. Babies with the new disorders added to Arizona's panel in 2006 became very ill, very quickly. Within the 24-72 hour collection window, we now recommend collecting the 1st specimen as soon after 24 hours of age as possible. The 2nd specimen should be collected between 5 and 10 days of age or at the first visit to a healthcare provider. All specimens should dry completely before being mailed. It is very important that each specimen is mailed within 24 hours after collection.

To review the updated Administrative Code (a.k.a. Rules), which lists the timing and information needed on specimen cards; check out this link to the Secretary of State's web site.

Our current blood test panel includes:

- 6 amino acid disorders (including PKU)
- 5 fatty acid oxidation disorders (including MCADD)
- 9 organic acid disorders
- Biotinidase deficiency
- Classic Galactosemia
- Congenital hypothyroidism
- Congenital adrenal hyperplasia
- 3 hemoglobin diseases

The diseases were chosen because they are ones where early identification and treatment could make a big difference in a baby's life.

For the complete list of disorders

- **Updated Legal Authority**

The Arizona Newborn Screening Program receives its authority from the Arizona Legislature. When bills become law, they are added to the Arizona Revised Statutes. The main Statute relating to newborn screening (Title 36, Chapter 6, Article 5, 36-694) can be found on the State Legislature website. Additional links to authority can be found on the Program website. In April of 2005, Senate Bill 1250 amended A.R.S. 36-694, authorizing expansion of the disorder panel and inclusion of follow-up services for hearing loss.

The Arizona Administrative Code is commonly referred to as the State Rules. The Administrative Code or Rules specifies how to carry out the law written in the Statutes. After the passage of Senate Bill 1250, the Rules were updated to reflect requirements of all parties involved in the screening processes. The updated Rules are available via the Secretary of State website.

- **Website**

The program's website was updated and reflects a simpler version of updates for parents, providers, and the general public. We will continue using our website as a main avenue for information distribution. The Arizona Newborn Screening Program website can be found at: www.AZNewborn.com.

- **Program Financing**

In 2006, the fee for newborn screening increased to compensate for expansion of the panel of disorders. The first screening now costs $30 and the $40 for the second screening. The first screening is typically paid by the hospital of birth and the second paid by the newborn's insurer. The program's fund remains separate from the ADHS general fund. All Newborn Screening Program activities and testing are funded by screening-fee collections, with the exception of a grant award from the Health Resources and Services Administration, Maternal Child Bureau. The grant offers $149,000 per year for some hearing screening activities and expires March 31, 2008.

- **Software Update**

In August of 2006, the program installed an updated version of the Natus Medical software called Neometrics™ (Natus Medical Neometrics website: http://www.natusmed.com/products/public_health/neometrics.html). This software allows the program to more easily track results and follow-up on abnormal values.

- **Learning Collaborative**

In 2006, the Arizona Newborn Screening Program began work in a Learning Collaborative, with eight other states, to reduce loss to follow up in newborns with possible hearing loss by working with the Medical Home. The National Initiative for Children's Health Care Quality (NICHQ) provided training and guidance for this project. The Learning Collaborative, comprised of parents, primary care providers, early intervention specialists in hearing loss, audiologists, public health administrators, hearing screeners, and neonatologist, used a model of rapid-cycle, small tests of change to improve the number of newborns meeting the goal of early intervention treatment by six months of age. The Learning Collaborative work will continue through 2007.

2006 Data

Note: Only a few cases of newborns with abnormal results remain open and unresolved.

Blood Spot

In 2006, 79 newborns were diagnosed with clinically significant disorders. The ADHS office of Vital Statistics Section recorded 103,734 births in 2006. Rates of inherited disorders are within the expected range for Arizona's population.

We confirmed the following diagnoses of babies screened:

- 45 cases of primary congenital hypothyroidism
- 1 case of other thyroid disorders
- 9 cases of salt-wasting congenital adrenal hyperplasia (CAH)
- 2 cases of simple virilizing CAH
- 1 case of other CAH
- 4 cases of phenylketonuria (PKU)
- 3 cases of biotinidase deficiency
- 8 cases of sickle cell anemia
- 5 cases of Hemoglobin SC
- 1 case of Beta-Thalassemia disease

100,588 initial blood spot screens and 89,757 second screens were tested. 2,519 specimens were considered unsatisfactory for testing. The follow-up team located 100% of affected infants who had screen results suggestive of target diseases. Of those who remained residents of Arizona after birth, all received needed services and accessed needed services within the timeframe determined as optimal by ADHS Newborn Screening. Of those residing out of Arizona immediately following birth, 100% were located and notified of need for further services. First specimens should be collected between 24 and 72 hours of age and mailed within 24 hours after collection. In 2006, 95% of all first specimens were collected within this period. The average first specimen was collected at 1.9 days of age and took 4 days to be received.

Hearing

Significant hearing loss is present in 1.8 to 3 out of every 1,000 newborn infants. It is important that babies with a hearing loss be identified and given appropriate treatment and intervention within the first six months of life. The first six months of life are a critical period for developing communication and language skills.

All 49 hospitals admitting newborns (all birthing and pediatric hospitals) voluntarily perform newborn hearing screening. Healthcare provides are required to submit the results of any hearing tests. All hospitals report results weekly. ADHS provides timely follow-up and maintains a database of all submitted results. We received results for 96% of all hospital births recorded by Vital Statistics in 2006.

Loss to follow up at one month of age was reduced from 60% to 40%.
Newborns referred for further testing was reduced from 6% to 4% (equals nationally accepted referral rate). Excessive referrals mean too many false positives, while insufficient referrals mean false negatives.

Continuing Activities

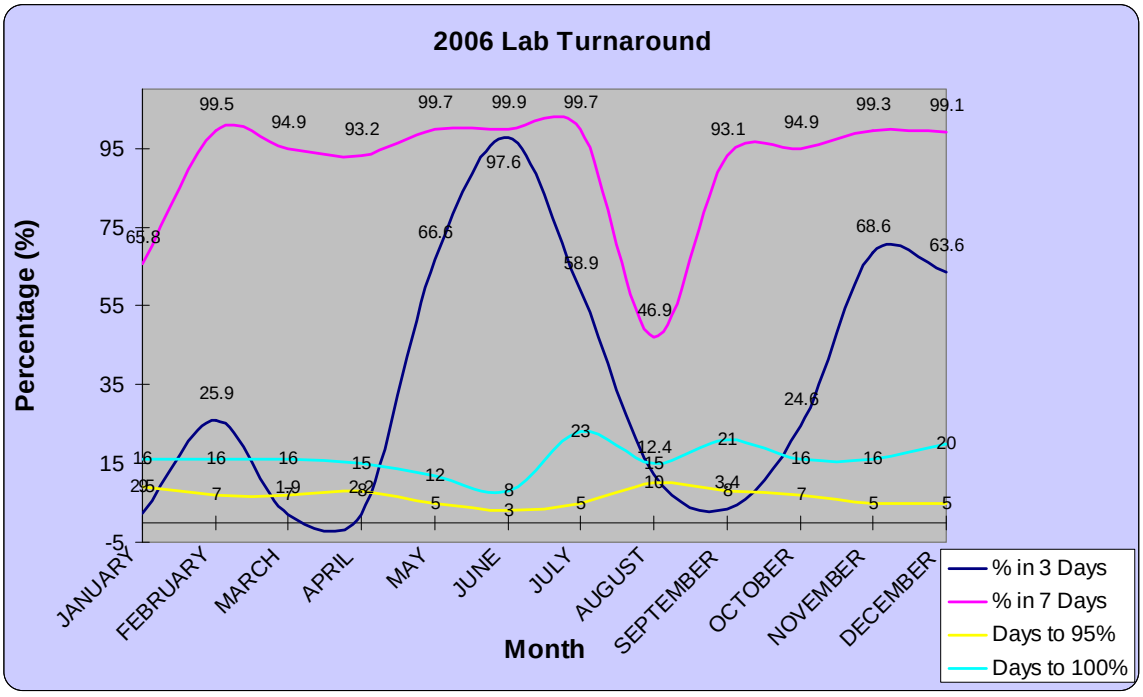
- **Laboratory**

2006 was a busy year. In April, our lab expanded its Amino Acid tandem mass spectrometry (MS/MS) panel to include Citrulline and Tyrosine. This event was quickly followed by transition of our MS/MS method from a using reagents prepared by the ADHS Laboratory to kits purchased from Perkin Elmer. The lab then began pilot testing for Acylcarnitines. After running thousands of specimens in order to establish appropriate cutoffs for our population, our lab began reporting a total of 26 analytes (20 disorders in all) via the MS/MS in September of 2006.

There were two other changes in laboratory methodology during the year. In the summer of 2006 the lab transitioned from using Perkin Elmer to BioRad products for galactosemia (GALT) testing. Late in 2006, our Hemoglobin Isoelectric focusing method was also altered in order to eliminate a staining step, which involved the use of hazardous chemicals.

The laboratory tracks many data, including turnaround time from specimen collection to reporting, unsatisfactory specimens, and specimens with incomplete information. In 2006, the reports needed were compiled and analyzed by the Quality Manager and related workgroups. Turnaround time (TAT), the time from receipt of a specimen to the time the results are mailed, for example, is analyzed daily.

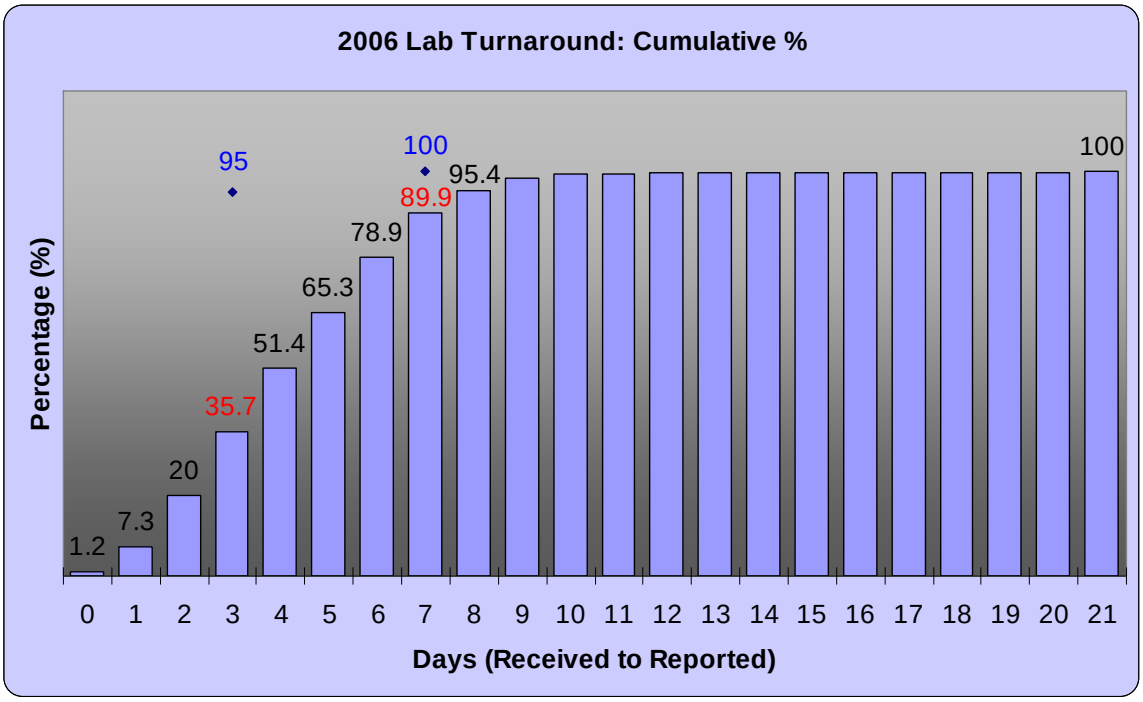
Figure 1: Percentage in 3 days, Percentage in 7 days, Days to 95%, & Days to 100%



The introduction of tandem mass spectrometry and an upgrade to our reporting software created significant issues in TAT in 2006. Aggressive efforts to correct and improve the TAT were implemented and TAT improved in November and December of 2006. Continued efforts indicate ongoing improvement.

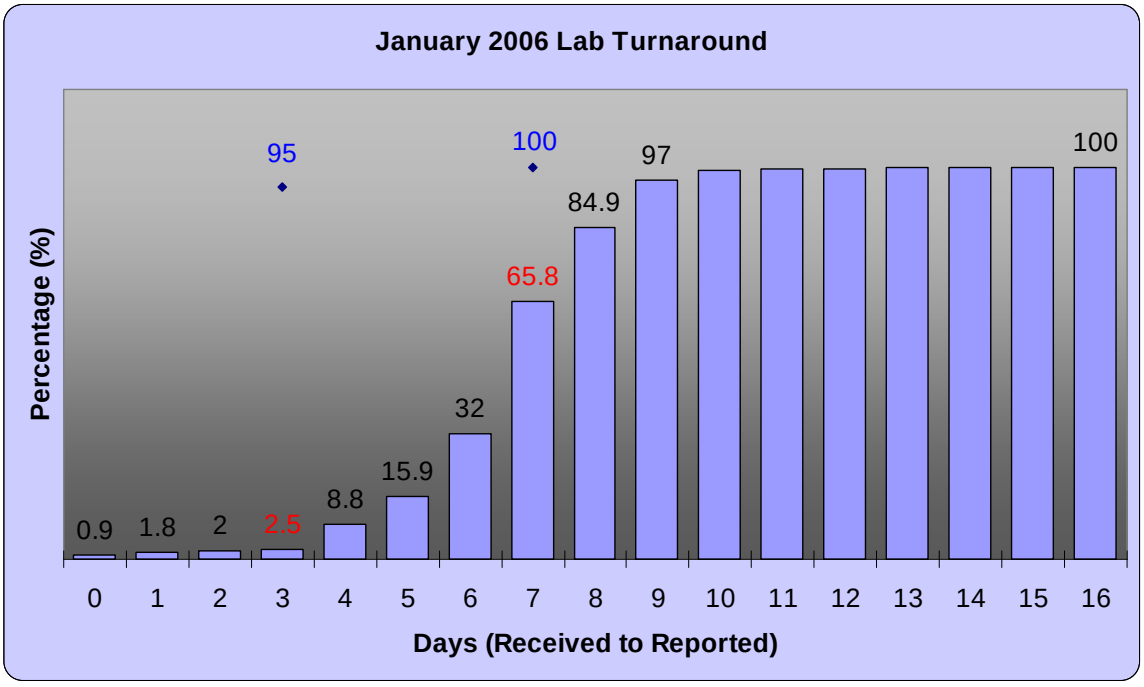
January and August were the only months when >93% of specimens were not reported within seven days. A specimen's results are reported when the necessary demographic information has been collected and entered into the newborn screening database. For 2006, incomplete specimen cards were the reason why no month reported 100% of specimens within seven days.

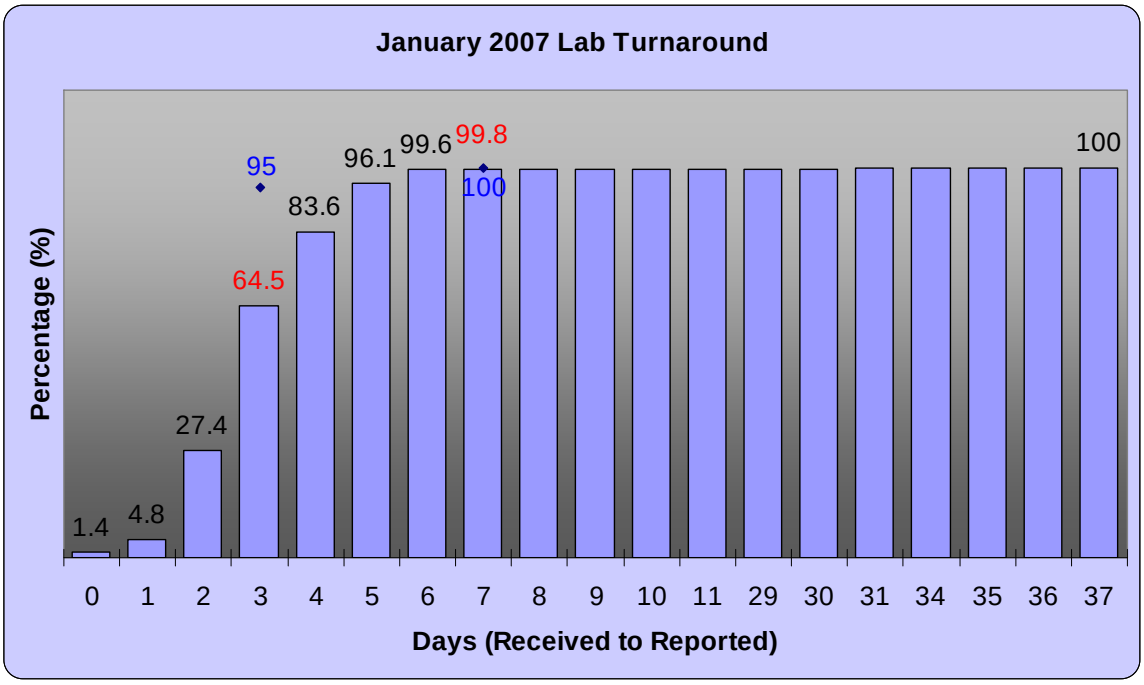
Figure 2: Cumulative Percentage of All Specimens



As a cumulative percentage, the laboratory reported 35.7% of specimens within three days and 89.9% within seven days. As mentioned earlier, incomplete specimen cards skew the days needed to reach 100% of specimens reported.

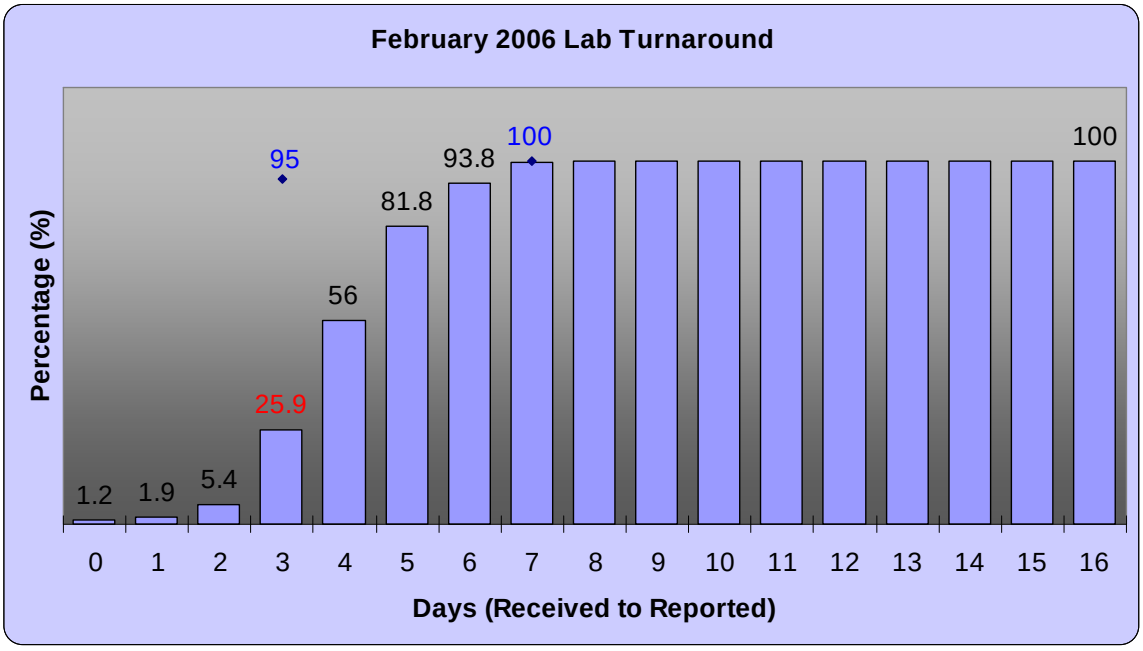
Figures 3 and 4: Comparison – January 2006 to January 2007

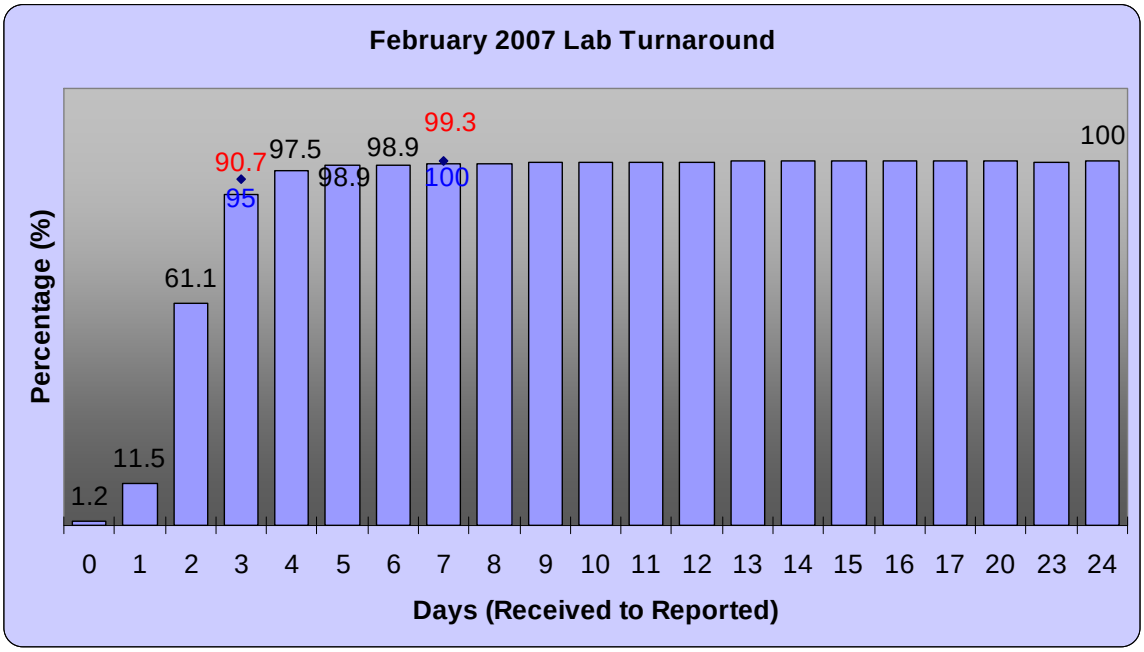




Turnaround within three days increased from 2.5% to 64.5%. Turnaround within seven days increased from 65.8% to 99.8%.

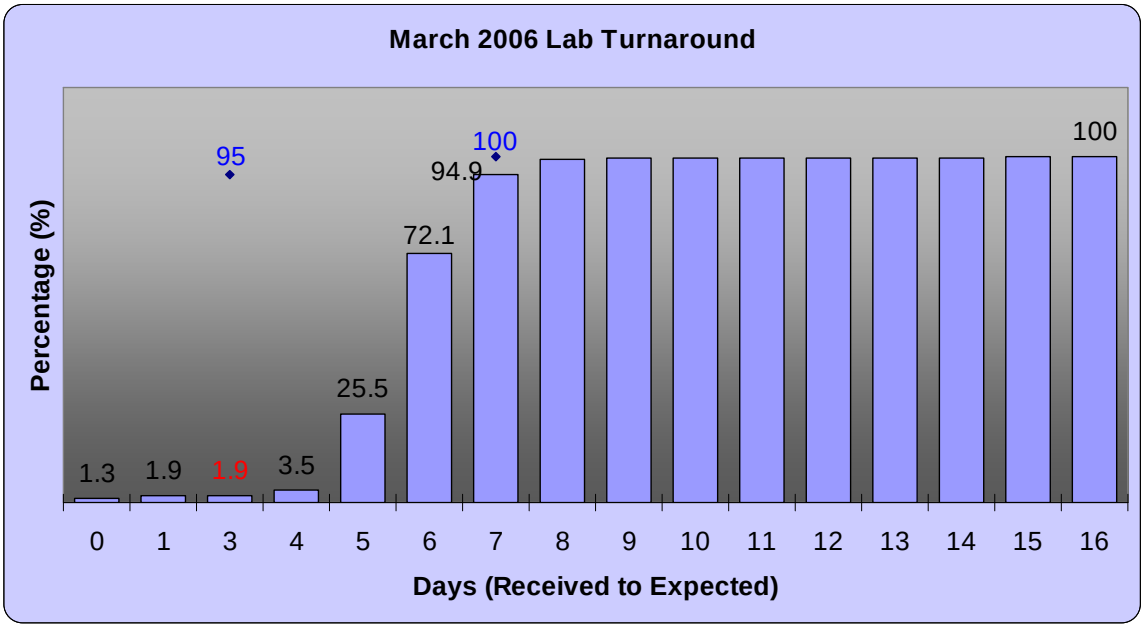
Figure 5 and 6: Comparison – February 2006 to February 2007

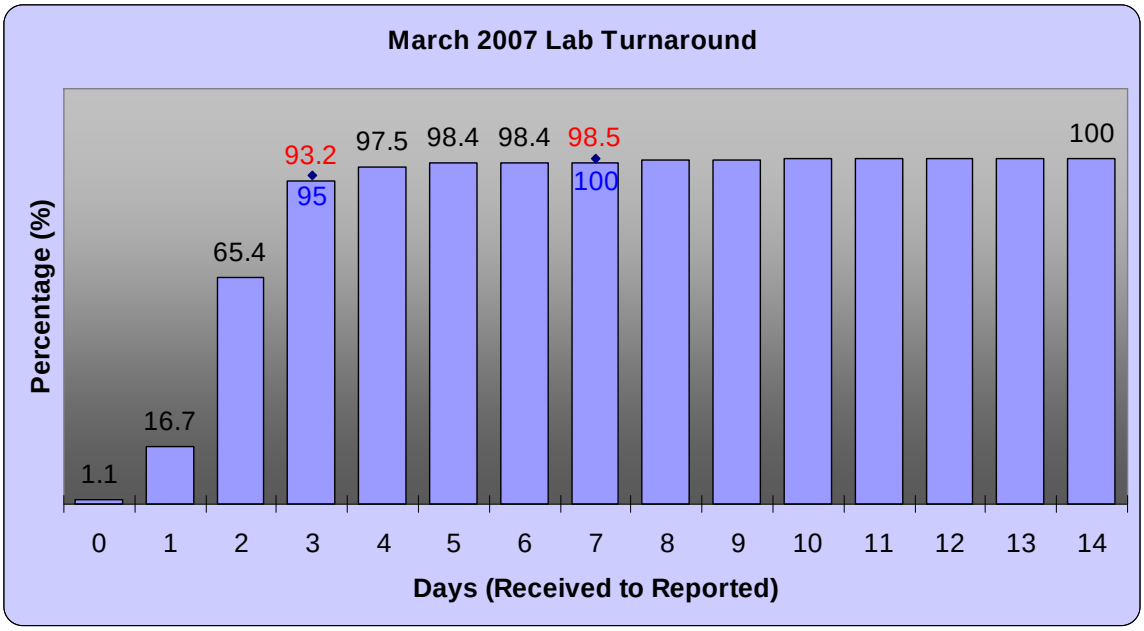




Turnaround within three days increased from 25.9% to 90.7%. Turnaround within seven days decreased from 100% to 99.3%.

Figure 7 and 8: Comparison – March 2006 to March 2007





Turnaround within three days increased from 1.9% to 93.2%. Turnaround within seven days decreased from 100% to 98.5%.

- ## Follow-up

The follow-up team, led by the Follow-up Manager, tracks each abnormal screening result to conclusion. Conclusion may include a repeat screening being normal, a diagnosis, or rarely death. The follow-up team assists in timely coordination of results between the laboratory and providers.

Follow-up lost two employees in 2006 but gained one who was promoted from another position within the program. Early in 2007, Follow-up hired several new employees.

To assist Follow-up Specialists, the program created a procedural manual, which includes, among other items, resources for locating newborns lost to follow up.

The Neometrics™ software upgrade included enhanced tools the follow-up team can use to more easily track events in the care for a newborn with abnormal screening results. Daily tasks can be divided among the program personnel and progress toward completely electronic (paper-light) follow-up is being made.

- ## Education

A new Educator began work near the end of 2006. Our new educator will, in 2007, assess the educational needs of customers (parents, providers, the public, and program staff). In addition, the educator will develop and deliver electronic and printed materials, schedule training sessions across the state, and develop short and long-range education plans.

For hearing, we created referral tools and education for families and providers. Please use our website, www.AZNewborn.com, as your one source for newborn screening information.

- ## Quality Improvement

A new Quality Improvement Manager began work near the end of 2006. In 2007, this person will monitor quality outcomes, analyze screening data for trends and identify opportunities for improvement. The program seeks to incorporate input from all sections of newborn screening, including: laboratory, demographic entry, follow-up, education, and dietary monitoring. We especially want feedback from our stakeholders, chief among them parents.

- **Nutrition and Dietary Monitoring**

Treatment of many disorders initially identified through newborn screening involves manipulation of dietary intake. Special dietary foods called medical foods are used in the treatment of screened disorders that are inborn errors of metabolism. Medical foods are described as modified low protein foods or metabolic formula. The Orphan Drug Act, Federal 1988 defines medical foods as food formulated for the consumption or administration enterally (via the gut) under the supervision of a physician and intended for the specific dietary management of diseases for which there are distinctive nutritional requirements recognized by scientific principals established by medical evaluation. The overall incidence of disorders that are treated with diet is approximately 1/5000 or about 12-15 new cases a year. Currently there are 174 children and 40 adult in Arizona who use medical foods treatment. Patients in poor dietary control due to lack of financial resources to purchase medical foods may find they need state assistance. Adequately treated patients live a fairly normal life and will become active members of society.

In 2000, House Bill 2043 required insurance companies to provide coverage of at least fifty percent of the cost of the medical foods with an annual cap of $5,000. However, private industries that have voluntarily established health plans must comply to federal law (ERISA) and are not required to follow Arizona statute. Under the Arizona statute, coverage is for necessary specially processed or treated medical foods under the supervision and direction of a physician.

Medical foods are very expensive. Management of the disorders includes the provision of both metabolic formula and low protein foods. A single can of normal infant formula is $10.00 compared to a single can of metabolic formula at $18.00- 80.00. Low protein foods are cost prohibitive and are not readily available. Regular spaghetti costs $ 1.25 in the grocery stores compared to low protein pastas that have to be purchased through mail order and costs $5.40 per pounds prior to shipping. Despite possible insurance coverage, the economic impact on families is substantial.

Listed below is the cost of medical foods per year for a person with PKU or other Amino Acid Disorders.

Age of patient	Modified Low Protein Foods Costs	Metabolic Formula	Total costs per year
1-4 years	$1908.00	$2592.00	$4500.00
4-7 years	$3181.00	$4320.00	$7501.00
7-11 years	$5089.00	$4800.00	$9889.00
11-adult	$5089.00	$4800.00	$9889.00
Pregnant women	$6997.00	$5497.00	$12,494.00

The cost for medical foods to a middle class family with private health insurance is approximately $4889.00 out of a total expense of $9889 per year or $407 per month on medical foods. Several families have more than one child with the disorder, which can double the cost to the family. Many families will not purchase the needed medical foods this negatively impacts the health of the patient, or they may go in to debt to purchase medical foods. Out of 174 children that have a metabolic diagnosis that requires manipulation of dietary intake, 104 children have private insurance and are financially impacted by the gap in insurance coverage.

Women with PKU that are not in control of the disease via dietary restrictions before and during pregnancy have a greater risk for miscarriage, birth defects and mental retardation. Since fifty percents of pregnancies are unplanned, women of childbearing age in good control of their metabolic disorder before and during pregnancy significantly reduce their risk to have children with health problems, including mental retardation. Although their children do not usually have the same metabolic disorder, they will require more health care and educational funds during their lifetime if they are born with mental retardation and/or birth defects, due to the teratogenic effects of poorly treated PKU.

Medical foods allow for better health outcomes for Arizonans with metabolic disorders and their children. Currently, there are gaps in coverage to provide medical foods to children and adults.

Story of Baby with Hearing Loss

As an audiologist for the past twenty-five years, it has been both amazing and rewarding to be involved in the positive outcomes related to early identification of hearing loss in infants. Identification and treatment of hearing loss prior to the age of six months keeps patients on target with language skills and related developmental milestones. In addition to conducting hearing screenings, our medical center has an Audiology Department, which streamlines inpatient and follow-up care. In combination with community resources, we are part of many successful outcomes related to hearing healthcare needs with our NICU population.

An example of a recent success involves a NICU patient who was delivered prematurely with Treacher Collins Syndrome. She has bilateral aural atresia/microtia. The Audiology staff completed bone conduction Auditory Brainstem Response testing at bedside. The Ear Foundation of Arizona was contacted and a representative (Lylis Olson) personally delivered a bone conduction hearing aid to loan to this patient. The patient's head circumference was measured so a headband could be sewn and modified to keep the bone oscillator on the patient's head. The hearing aid fitting was completed in the NICU, with demonstration of use and care provided to the mother. The patient's tow year old sister and mother were the first family members to speak to the patient with her bone conduction hearing aid in place. The fitting was completed by the time the patient's corrected age was forty weeks, her actual due date!

The NICU team members: neonatologists, nurse practitioners, nurses, aids, social services, were all part of the interdisciplinary team involved in this patient's care. All were supportive and most pleased with the ability to help this patient hear even before she went home from the hospital. The NICU team also assisted in referring the family to Children's Rehabilitation Services, where the patient eventually obtained her own permanent bone conduction hearing aid.

The hearing health care provided to this patient, while still in our NICU, demonstrates the successful collaboration of internal and external resources to make a difference. We are proud to have been a part of these processes, which result in early identification and treatment of hearing loss in infants and prevent communication delays.

Future Plans

- ## Cystic Fibrosis (CF)

The program will begin screening for cystic fibrosis in October of 2007. Planning has been coordinated with various stakeholders, including Arizona's two CFF-accredited cystic fibrosis centers (Phoenix Children's Hospital and Arizona Respiratory Center). Our stakeholders feel confident the cystic fibrosis screening will be a success.

The process will involve an initial screen by Immunoreactive Trypsinogen (IRT). Specimens with IRT values within a range typical of CF patients will be screened for DNA mutations. DNA results indicating CF will be reported to the CF center closest to the patient's family. The CF center will coordinate further testing with the patient's healthcare provider. Newborns identified through screening will be referred for sweat testing at the CF Center.

DNA results will indicate that a patient may either have cystic fibrosis, may be a genetic carrier of the DNA mutations associated with cystic fibrosis, or is not likely to either have the disease or be a carrier. All DNA results will be interpreted for families.

- ## Electronic Provider Access

One of the program's goals is to create a way for providers to electronically check screening results themselves. We are in the planning phases of this project.